Improving Fingerprint Capture using "Auto Capture"

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Overview for Auto Capture

- Motivation
- Overview
- Testing Process
- Testing Results
- Testing Issues
- Further Work

Market Motivation

- Kiosks
  - Environments where there are no operators
- Untrained Operators
  - New Employees
  - New Equipment
  - New Application Contexts
- Busy Operators
  - Multitasking Roles
  - Migration from Capture to Quality Control

Technical Motivation

- Objective Decision Framework
  - People are not consistent
  - People get tired
  - People get distracted
- User Selection Latency
  - Quality Decision Time (200-400 msec)
    Often slower than the image frame rate
  - Software User Interface Latency (200-300 msec)
- Best Image Frame Possibility
  - Auto capture allows the possibility to examine all the image frames, and select the “best” one
- Potential for adaptive cost function
  - Under significant load, the time may be more important than the quality
  - Under light load, the objective function can heavily emphasize the best quality

Description

- The Auto Capture process is composed of several sub processes…

Sample Capture

Rapid Segmentation

Rapid Quality

Decision Process

User Interface

CROSSMATCH® TECHNOLOGIES

Sample Capture

- An imaging system takes a series of “photographs” at a given frame rate.
- Depends on many factors
  - Sensor Electronics
  - Capture Time
  - Sensor Dynamic Range
  - Image Resolution
  - Platen Size
  - Imaging Size
  - Computer Interface

Sample Capture

Rapid Segmentation

Rapid Quality

Decision Process

User Interface

CROSSMATCH® TECHNOLOGIES

Rapid Segmentation

- Driven by flats capture requirements
- An image must be classified into background and friction ridge regions
- Friction ridge regions must be classified into fingerprint areas and “other” areas

Sample Capture

Rapid Segmentation

Rapid Quality

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User Interface

CROSSMATCH® TECHNOLOGIES

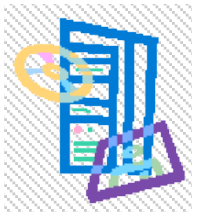
Rapid Quality

- Fingerprint regions must be assessed
  - Size
  - Shape
  - “signal to noise”
- This must be done on a frame by frame basis for each fingerprint
- NFIQ is currently not feasible for rapid quality
  - Extraction Time
  - Quality Issues

Sample Capture

Rapid Segmentation

Rapid Quality



Decision Process

User Interface

CROSSMATCH® TECHNOLOGIES

Decision Model

- Stable Frame Quality
- Peaked Finger Quality
- Cost Function
- Cross Finger Quality
- Pinky/Ring Weighting

Sample Capture

Rapid Segmentation

Rapid Quality

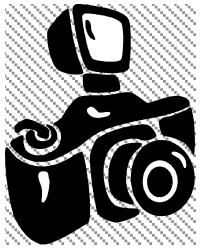
Decision Process

User Interface

CROSSMATCH® TECHNOLOGIES

User Interface

- Frame Speed
- Indicator per Finger
- Display Placement
- Local Scanner Feedback



Sample Capture

Rapid Segmentation

Rapid Quality

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CROSSMATCH® TECHNOLOGIES

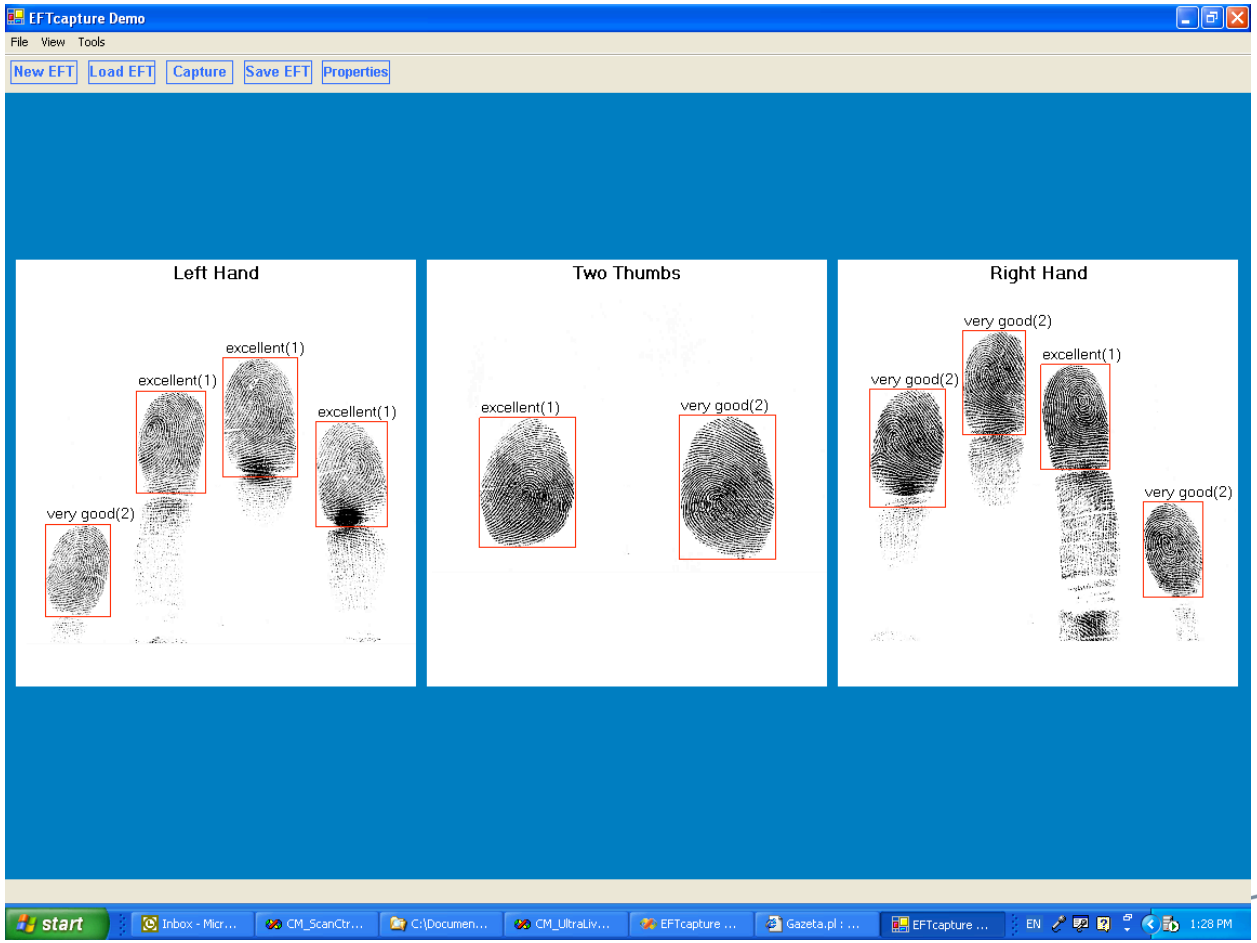
Raw Fingerprint Images

Notice the long right ring finger

Raw Fingerprint Images

A fairly typical left slap

A Typical Fingerprint Capture



Testing Process

- User Selection
  - Poor fingerprints remain poor, regardless of operator or auto capture…
  - Good fingerprints are easy to capture
- Data to Collect
  - NFIQ Quality Scores
  - Capture Times
  - Operator, Observer, Kiosk
- Data Collection Process
  - 1 user at a time (no ~training)
  - Caller
  - Recorder (6 finger scores, 1 time)
  - 27 Subjects

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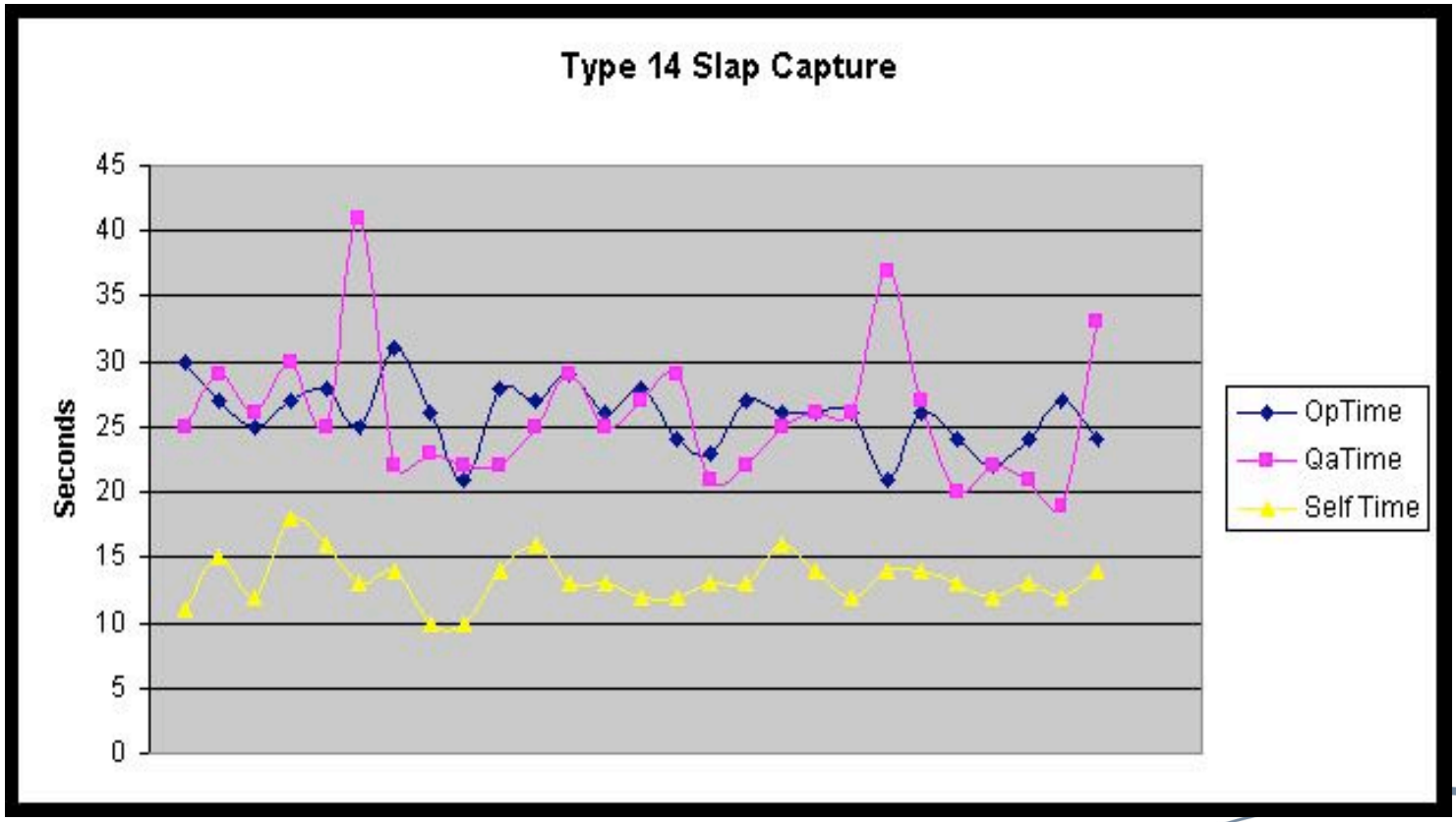
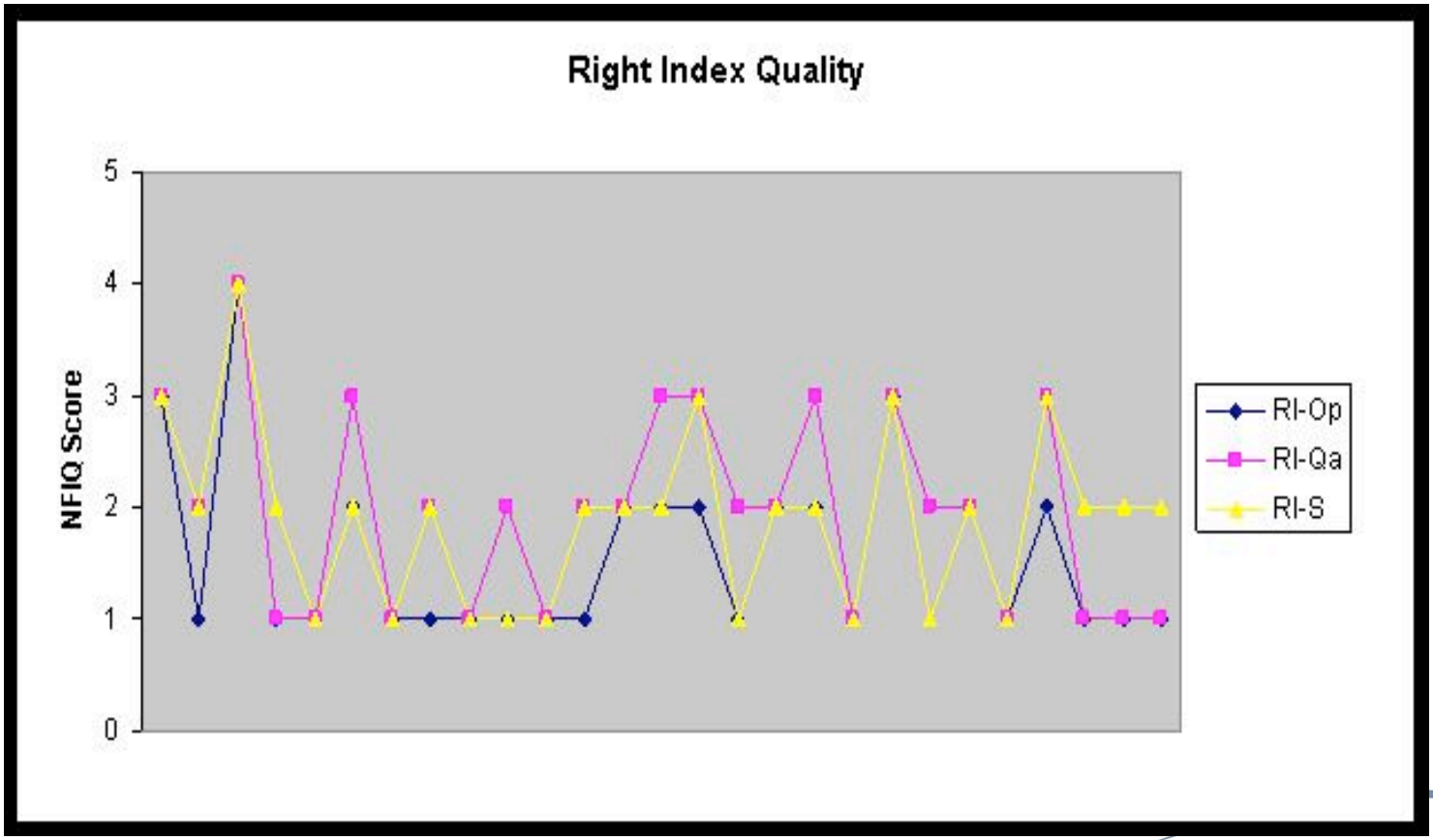
Testing Results



Testing Results



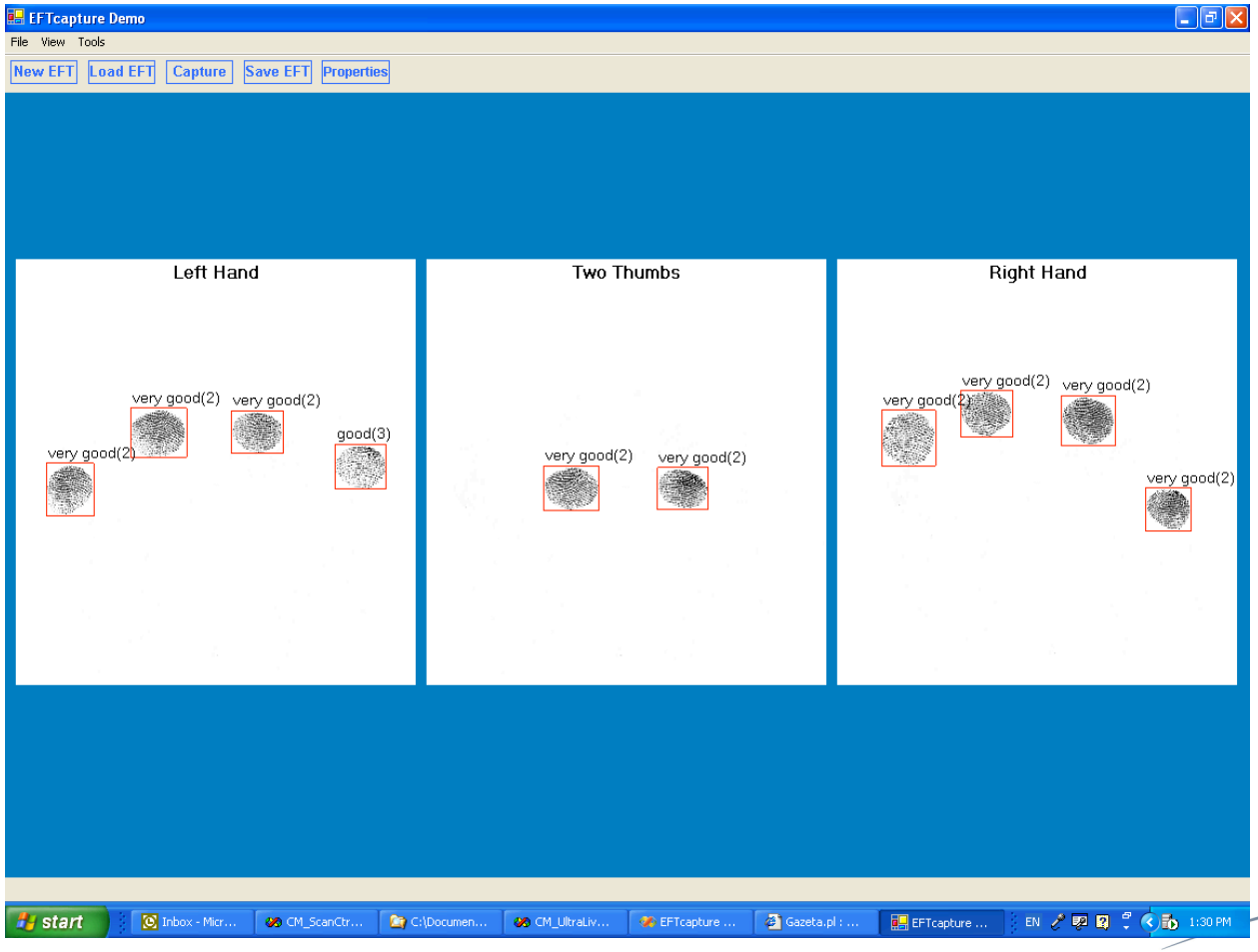
Issues

- Hand Detection (Rotation)
- Segmentation Issues
- Platen Material
  - Latents
  - Dry Prints
- Training
  - Tips, Full Fingers
  - Pressure

NFIQ Issues

- Fingerprint Tips (Tips of Tips)
  - They get very generous scores
- Granularity
  - Only 5 levels of granularity, and there was not many fingerprints below a 3.

The Tips….


EFTcapture Demo
File View Tools
New EFT
Load EFT
Capture
Save EFT
Properties
Left Hand
very good(2)
very good(2)
very good(2)
good(3)
Two Thumbs
very good(2)
very good(2)
Right Hand
very good(2)
very good(2)
very good(2)
very good(2)
start
1:30 PM

Future Work

- More People
  - More Expert Operators
  - More Novice Operators
  - More Applicants
    - Good Fingerprint Quality
    - Medium Fingerprint Quality
    - Poor Fingerprint Quality
- Optimal parameters
  - Decision Block
  - Signal Processing Block
- Better Algorithms
- Better UI
- Suboptimal Equipment/Environment
  - Distracted Operators
  - Dirty Platens

Summary

- Auto Capture drastically improves capture speed
- Auto Capture can improve NFIQ quality scores for poor fingerprint placement issues (tips of tips)
- Auto Capture typically improves quality with “passive” operators
- NFIQ may not be the best tool to measure an auto capture process.
- Further work is needed